Claim 24 recites:

> A method of joining composite parts comprising: inserting a plurality of reinforcing elements through the thickness of two composites adherands to be joined, each composite adherend containing fibers in a resin matrix, said reinforcing elements inserted transverse to the direction of the fibers in resin matrix, said reinforcing elements left extending from the joint surface of each adherend;
>
> assembling said adherends one on top of the other so that the joint surface of one said adherend faces the joint surface of the other said adherend defining a joint region therebetween, said extending reinforcing elements interstitially disposed in said joint region; and
>
> disposing an adherent within said joint region about said interstitially disposed reinforcing elements and said joint surfaces.

The Examiner cites the 783035 publication stating that the "strands" of this reference can be seen to be equivalent to the reinforcing elements claimed by the applicant. The "strands" referred in this publication, however, run longitudinally or in the direction of the belt, not "transverse to the direction of the fibers" as claimed by the applicant. Moreover, the strands are not "inserted through the thickness of the two composite adherands" as claimed by the applicant prior to forming a joint.

Instead, "the ends of the ropes (cables) are separated and divided into their strands". See the abstract. This is completely different from the claimed methodology which requires that the reinforcing elements are inserted through the thickness of two composite parts in the direction transverse to the direction of the plies of fibers already in the composite parts.

The applicant inserts rods transversely through the plies; the reference merely separates and divides the longitudinally running plies to reveal the individual longitudinally running strands.

The Examiner also feels that Holko teaches the steps of disposing or inserting reinforcing elements through the thickness of a composite part citing columns 2, lines 11-43, 52-60 and claim 1. Column 2, lines 11-43 and 52-60 in claim 1 are repeated here verbatim:

> The present invention may be described by reference to the drawings.
>
> Carbon-carbon composite components 1 and 2 are to be joined. The surfaces to be joined 3 and 4 are prepared so that they match. (The surfaces may be serrated to increase the joint area as shown in Fig. 1B). The surfaces are cleaned and loose material is removed. A thin interlayer 5 is assembled between surfaces 3 and 4 as shown in Fig. 1C and the assembly is heated at a temperature at or above the melting point of the interlayer material or at a temperature sufficient to cause interdifussion between the interlayer and the carbon-carbon composite. During the heating process the assembly is held together under compression by clamp 6. The heating is done in a vacuum, in an inert gas atmosphere or in an atmosphere which will produce or enhance the desired chemical reactions. The assembly is then cooled.
>
> An enlargement of a typical completed joint is shown in Fig. 2. As shown at 7, the interlayer material has diffused into the material of components 1 and 2 and the composite material has diffused into the interlayer material. Interdiffusion is generally limited to about 0.010 inch, but in cases here the interlayer has been forced to melt, the inventor has observed evidence of the flow of liquid metal up to 0.060 inch into the carbon-carbon material.

Interlayer materials are selected from reactive and refractory metals and compounds or other materials that will react during the joining process to produce refractory, high temperature compounds. The interlayers may be applied in the form of foils, compound powders, mixtures of elemental powders, or mixtures of compound and/or elemental powders.

In order to improve bonding, carbon-carbon surfaces may be modified by ion implantation or ion mixing. Ion implantation involved propelling ions toward the sources. The ions are embedded to a depth of up to several hundred angstroms into the carbon-carbon microstructure. Ion mixture involves first coating the surfaces by a process such as sputtering or chemical vapor deposition then bombarding the surface with high energy ions. Coating and components atoms are thus mixed together.

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1. A process for joining carbon-carbon composite component comprising the steps of:

(a) preparing the surface of a first carbon-carbon composite component to be joined,

(b) preparing a surface of a second carbon-carbon composite component so that the surface of said second component mates with said prepared surface of said first component,

(c) preparing a thin interlayer having a thickness of between 0.001 inch and 0.004 inch and comprised of material having a melting point greater than 2500F.

(d) assembling said first component, said interlayer and said second component so that said mating surfaces are facing each other with said interlayer sandwiched between, and

(e) while holding said assembly together under compression, heating for a time said assembly at a temperature not exceeding 36650 F. but sufficient to cause substantial mixing of the atoms of the interlayer with the atoms of the carbon-carbon composite.

Holko describes serrating the surfaces (Fig. 1B) but it can clearly be seen that no reinforcing elements are

inserted into the part or are left extending from the joint surface of each adherent as claimed by the applicant in claim 24. Compare Holko, Figs. 1B and 1C with the applicants Fig's 2, 3, and 4. Note, column 2, line 63 through column 3, line 1: Holko machines each part to a surface finish to about 8 RMS. Clearly there are no reinforcing elements left extending at the joint region if the surfaces of each part machined

Clearly Holko fails to teach inserting reinforcing elements through the thickness of two composite adherands to be joined in the direction transverse to the direction of the plies of fibers. Clearly Holko fails to teach or suggest disposing an adherent within the joint region about the interstitially disposed reinforcing elements. Holko also describes various interlayers materials such as Zr and ZrC and ion implantation wherein the ions are "imbedded" to a depth of up to several hundred angstroms into the carbon-carbon microstructure. This is not, however, the equivalent of driving reinforcing elements through the thickness of each adherend in a direction transverse to the plies of fibers in the resin matrix and leaving them extending prior to disposing an adherent between the two adherents and about the interstitially disposed extending reinforcing elements.

No art suggests a method of joining composite parts comprising: inserting a plurality of reinforcing elements through the thickness of two composites adherands to be joined, each composite adherend containing fibers in a resin

matrix, the reinforcing elements inserted transverse to the direction of the fibers in resin matrix, the reinforcing elements left extending from the joint surface of each adherend; assembling the adherends one on top of the other so that the joint surface of one adherend faces the joint surface of the other said adherend defining a joint region therebetween, the extending reinforcing elements interstitially disposed in the joint region; and disposing an adherent within the joint region about the interstitially disposed reinforcing elements and the joint surfaces.

Also, the applicant claims that the composite parts may be in the form of a "prepreg" material before the reinforcing elements are inserted and the joint is made. The joined assembly is then cured. See claim 7.

The publication clearly fails to show the use of "prepreg" materials and instead is related only to conveyor belts. Conveyor belts are simply not formed from "prepreg" material. Holko specifically teaches using cured composite material from General Dynamics known as "K-Carb". Clearly, there is no teaching related to the use of "prepregs" which more easily accept the reinforcing elements, the use of a prepreg material as the adherent,, and the step of curing a completed joined assembly as claimed by the applicant.

Each of Examiner's rejections has been addressed or traversed. Accordingly, it is respectfully submitted that the application is in condition for allowance. Early and favorable action is respectfully requested.

If for any reason this Response is found to be incomplete, or if at any time it appears that a telephone conference with counsel would help advance prosecution, please telephone the undersigned or his associate, Joseph S. Iandiorio, collect in Waltham, Massachusetts, (617) 890-5678.

Respectfully submitted,

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